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COMPARATIVE DESIGN STUDY OF FERRO CEMENT WATER TANK AND RCC WATER TANK

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Abstract: *Water tanks that are constructed from wire reinforced cement and mortar are used in many purposes such as for collecting water for domestic, stock, irrigation and industrial purposes. These tanks are constructed from cement sand mortar on a mesh of wire reinforcement to form cylindrical tanks giving the minimum thickness of about 3cm to 10 cm depending on the size of the tank. The purpose of this study was to check the design details of Ferro cement. To calculate the amount of steel required in RCC and Ferro cement structure and the result concludes that the amount of steel in Ferro cement structure is more while in RCC structure it is less while the steel covering the area is more in Ferro cement structure and in RCC structure it is less due to which Ferro cement structure are better than the RCC structure.*

Keyword: **Ferro-cement, wire mesh, Ferro-cement water tank, RCC Water tank, Rich Mortar**

1. INTRODUCTION

Ferro cement water tanks are from inside and outside with a thin layer of cement & mortar. This tank can be used for individual household or for whole communities. Ferro cement water tanks are relatively expensive but are easy to maintain. To avoid bending forces in the material, most Ferro cement tanks have curved walls, so the appearance or shape of Ferro cement tanks can be of a cylinder, a globe or an egg. Compared to concrete reservoirs,

Ferro cement tanks or these tanks are light and flexible. The method to manufacture this tank is hand travelling a cement rich mortar on to a mess of were reinforcement to form cylindrical tanks with thin walls vary in thickness 3 to 10 cm depending on size of the tank.

Fig-1: Ferro cement

2. REVIEW OF LITERATURE

A. R. Khandelwal, S S Deshmukh according to their work gave results that the ground water level is depleting every year. Dams of small size on small natural streams can fulfill the groundwater. Ferro cement technology is looked upon as an alternative to traditional and most conventional concrete structures. There are many benefits of Feṛro cement technology over the conventional methods due to properties of Ferro cement like construction of thin wall, adaptability to any shape etc. Randhir J. Phalke, Darshan G. Gaidhankar in their work gave the conclusion of testing of panels made up of Ferro cement with variant numbers of wire mesh layers is described. The main objective is to analyze the results by using different layers of wire meshes in the panels. Using the steel fibers 0.5% of total volume and the aspect ratio of l/d=57 some panels were constructed and then tested in the UTM machine after 28 days and 7 days. Martirena Hernandez in his work gave the conclusion that to construct a low cost Ferro cement water tank for water storage. At present was only used for storage but it can also be taken for other liquid structures and to improve the structural behavior of wall the revolution of hyperboloid. B.Antonin Gnana Jenofer , U.Prem Anandh, R.Dhinesh , S.Kumar gave the conclusion in their work that Ferro cement storage water tank is more economical and at the same time no changes in strength, rigidity and workability. By the theoretical design and estimation it can be 10 to 20% economical than the RCC water tank and easy to construct with less labor. But by

the practical results have proved that it is at least 40% economical than the RCC water tank.

3. STUDY AREA

The reduction of the depth of the beam is needed to get clear height which is not possible in singly RC beam where doubly RC beam becomes costlier therefore we can use Ferro cement beam. In RCC, cracks formation happens due to shrinkage and leakage because of that reinforcement gets corroded whereas the formation of cracks in Ferro cement structures are less due to which shrinkage and leakage does not take place.

Different shapes of structure require more amount of formwork and it is hard to construct due to which it becomes costlier and hence Ferro cement can be used because no formwork is required. In RCC structure due to load the expansion and contraction take place in the RCC structure due to which leakage occurs and cracks repair and maintenance in RCC structure becomes costlier.

The reinforcement used in RCC structure is costlier as a replacement we can use numbers of wire mesh and skeletal reinforcement for the construction. It would be less costly than reinforcement steel in RCC structure.

4. OBJECTIVE

Ferro cement have high potency as the mortar is used due to which the amount of cement is high in the structure. Since, in Ferro cement wire mesh is covered all over the cross section area, we get an equal composition and steel bar is less required and formwork is not required in some structures. Ferro cement can be molded into any desired shape and it costs less compared to the RCC structure.

5. MATERIALS AND TESTS

5.1 Ferro cement Materials

The materials required for the construction of Ferro cement water tank are

1. Cement
2. Sand
3. Water
4. Wire Mesh

Cement: Ordinary Portland cement of grade 43 conforming to IS: 8112-1989 which was stored in a cool and dry place before used Physical properties of cement, is found compressive strength at 28 days is 44.10 N/mm square.

Sand: Fine aggregate used in the light weight Ferro cement is taken from river bed. This river sand is mostly free from all impurity and organic matters.

Water: Ordinary potable drinking water free from organic matter, silt, oil, sugar, chloride and acidic material was used for mixing.

Wire mesh: Galvanized woven square meshes of 6 x 20 gauges size (0.55 mm average wire diameter at 4.17 mm nominal spacing), have been used. The tensile strength of the mesh is found as 435 .86 N/mm2. The square welded wire steel mesh was used in the construction of Ferro cement structure.

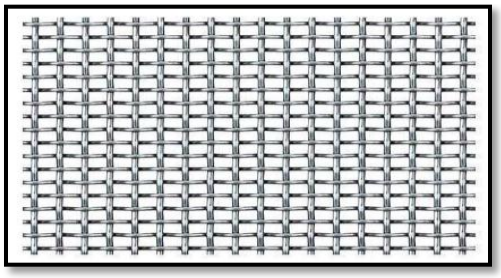

Fig-2: Wire mesh

5.2 Ferro cements Tests:

1. **Compressive strength of Ferro cement**: The test compression strength can be performed by casting 15mm*15mm*15mm dimensions cubes using cement mortar 1:3 proportion and water cement ratio is 0.45. Welded mesh is cut in dimension 149mm*149mm. This mesh is made using two layers of chicken mesh and tied and making the skeleton. Mould is filled with cement mortar up to a depth more than 5mm with the help of vibrations for good compaction. After that the mesh is placed over the compacted mortar and then the fresh layer pf mortar is placed and compacted with vibrators and again the layer of mortar is placed.

Fig-3: Ferro cement cube

2. **Flexural strength of Ferro cement**: The test flexural strength can be performed by casting the beam of size

100mm*600mm*50mm dimensions using cement mortar in proportion 1:3 with water cement ratio 0.45. Welded mesh is laid with the two layer of chicken mesh and tied and making the steel skeleton. Cement mortar is placed in mould up to depth more than 5mm and then compacted with vibrators for uniform compaction. The skeleton placed over the compacted layer. Then the layer of fresh mortar is placed and again compacted with vibrators.

Fig-4: Ferro cement beam

3. **Split tensile strength of Ferro cement:** The test split tensile strength can be performed by casting 150mm*300mm dimensions cylindrical specimens using cement mortar in proportion 1:3 with w/c ratio 0.45. Welded mesh is cut in dimension 149mm*300mm. This mesh is placed with two layers of chicken mesh and tied and making the steel skeleton. This skeleton will be played in cylindrical specimen in a vertical position. The cement mortar is prepared as above proportion mortar will be placed after the skeletons are placed in the cylinder. For circumferential laying, make a chicken mesh with cylindrical shape having diameter 145mm and placed inside the core. After that mortar is laid. Likewise other cylinders of having diameter 140mm will be made and placed inside the core and mortar is laid.

Fig-5: Ferro cement cylinder

6. DESIGNING

6.1 Design of RCC water tank and Ferro cement water tank

Data:

- Capacity of tank : 75000 Liter
- Volume of tank : 75 cubic meter
- Depth of tank : 4 meter
- Diameter of tank : 5 meter
- Free board : 0.2 meter
- Grade of concrete : 30N/mm^2
- Steel : 415N/mm^2
- permissible stress in compression : 10 N/mm^2
- permissible stress in tension : 130 N/mm^2
- modular ratio m : 9.33
- neutral axis constant k : 0.41
- lever arm constant j : 0.86

6.2 Load Calculation

- Self weight: 3 kN/m
- Floor finish: 0.5 kN/m
- Live load: 2 kN/m

Total factored load: 8.55 kN/m

6.3 IS CODES for design

- IS: 3370(Part-2)-2009 Table-1
- IS: 3370(Part-2)-2009 Table-2
- IS: 3370(Part-2)-2009 Table-4
- IS: 13356:1992

Reinforcement detailing:

Table- 1: Reinforcement detailing

COMPONENTS	DETAILING IN RCC	DETAILING IN FERRO CEMENT
Thickness of top slab	120 mm	120 mm
Reinforcement in top slab	10 mm Ø @ 273mm c/c	2 mm Ø @ 11mm c/c
Thickness of wall	200 mm	200 mm
Reinforcement in top portion of wall	10 mm Ø @ 209 mm c/c	1.25 mm Ø @ 4 mm c/c
Reinforcement in middle and bottom portion of wall	10 mm Ø @100 mm c/c	1.25 mm Ø @ 2 mm c/c
Vertical reinforcement	10 mm Ø @164 mm c/c	8 mm Ø @ 67 mm c/c
Thickness of base slab	75 mm	75 mm
Reinforcement in base slab	8mm Ø @280 mm c/c	1.25 mm Ø @ 7 mm c/c

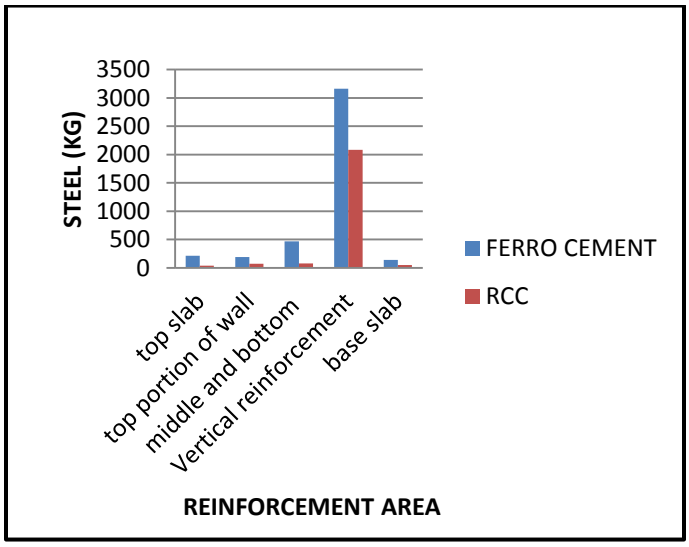

Chart-1: Steel quantity (Reinforcement area vs. steel(kg))

7. DETAILING OF FERRO CEMENT AND RCC WATER TANK

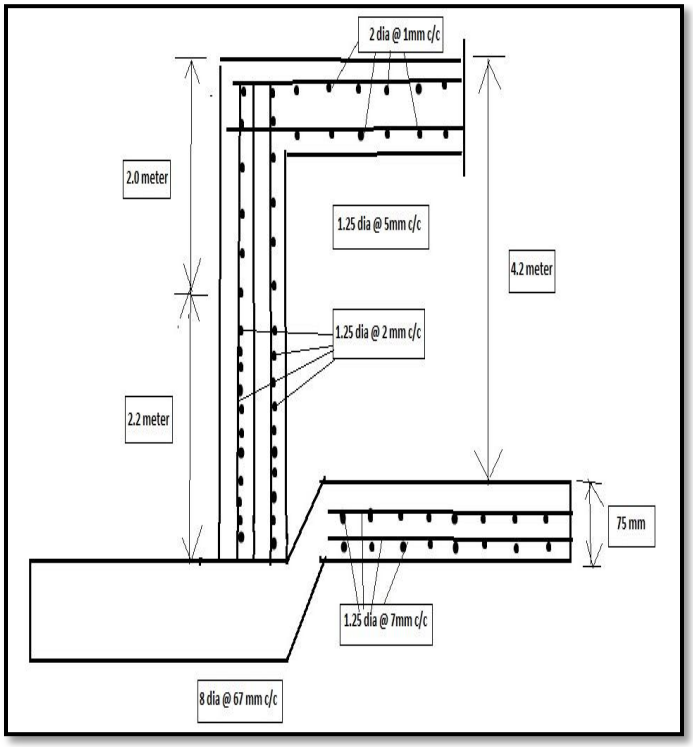

Fig-6: Ferro Cement Water Tank Cross Section

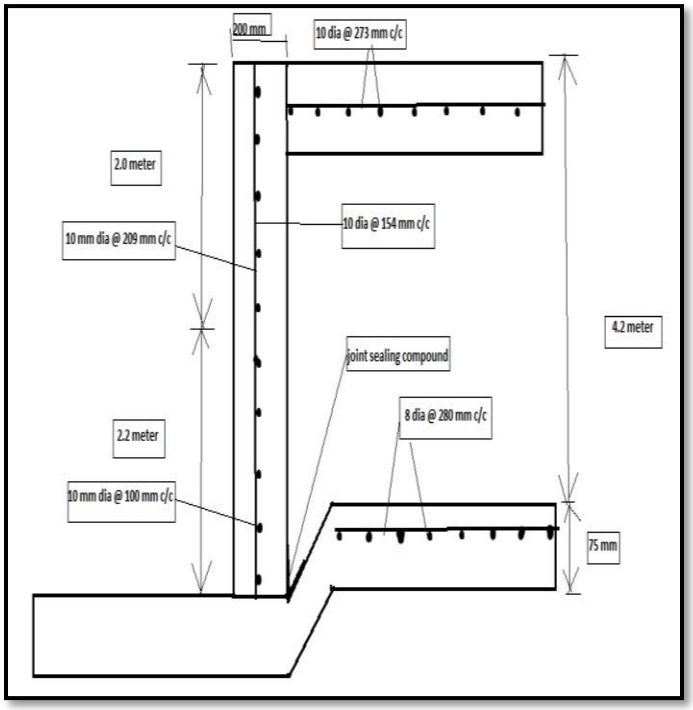

Fig-7: RCC Water tank Cross Section

8. CONCLUSION

Through the design and graph we conclude that the amount of steel present in the RCC structure is less as compare to the Ferro cement. As well as the steel covering the surface area of steel is more in Ferro cement water tank than in the RCC water tank. Therefore we can analyze that the steel covered in the Ferro cement structure is more due to which it is more better than RCC structure as well as the cost of the wire mesh required in Ferro cement is less as compare to the steel in RCC water tank

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